

IN THE CLAIMS:

1 1. (Currently Amended) A method for distributing parity blocks across a disk array, the
2 method comprising the steps of:

3 adding a new disk to a number of pre-existing disks of the array;

4 dividing each disk into blocks, the blocks being organized into stripes such that
5 each stripe contains one block from each disk; and

6 distributing parity among blocks of the new and pre-existing disks ~~without recal-~~
7 ~~ulation or moving of any blocks containing data~~ by moving every Nth parity block to the
8 new disk to arrange each disk of the array with approximately 1/N parity blocks, where N
9 is equal to the number of pre-existing disks plus the new disk.

1 2. (Original) The method of Claim 1 wherein the step of distributing comprises the step
2 of distributing parity among blocks of the new and pre-existing disks in a manner that
3 maintains a fixed pattern of parity blocks among stripes of the disks.

1 3. (Original) The method of Claim 1 wherein the step of distributing comprises the step
2 of changing an assignment for one or more blocks containing parity of each pre-existing
3 disk to the newly added disk.

1 4. (Original) The method of Claim 2 wherein the step of adding comprises the step of
2 initializing the added disk so as to not affect parity of the stripes.

1 5. (Original) The method of Claim 4 wherein the step of initializing comprises the step
2 of reassigning blocks containing parity in certain stripes to the new disk without calcula-
3 tion or writing of parity.

1 6. (Cancelled)

1 7. (Original) The method of Claim 5 wherein the step of reassigning comprises the step
2 of changing a block containing parity (parity block) to a block containing data (data
3 block) and not changing a data block to a parity block.

1 8. (Cancelled)

1 9. (Cancelled)

1 10. (Currently Amended) A system adapted to distribute parity across disks of a storage
2 system, the system comprising:
3 | a disk array comprising a number of pre-existing disks and at least one new disk;
4 | and
5 | a storage module configured to compute parity in blocks of stripes across the
6 disks and reconstruct blocks of disks lost as a result of failure, the storage module further
7 | configured to assign the parity among the blocks of the new and pre-existing disks ~~with-~~
8 | ~~out recalculation or moving of any data blocks by moving every Nth parity block to the~~
9 | new disk to arrange each disk of the array with approximately 1/N parity blocks, where N
10 | is equal to the number of pre-existing disks plus the new disk.

1 11. (Original) The system of Claim 10 further comprising a table configured to store par-
2 ity assignments calculated for one of a known group size of the disk array and a maxi-
3 mum group size of the array, the stored parity assignments defining a repeat interval of a
4 parity distribution pattern used to determine locations of parity storage on any disk in the
5 array.

1 12. (Original) The system of Claim 10 wherein the storage module is embodied as a
2 RAID system of the storage system.

1 13. (Original) The system of Claim 10 wherein the storage module is embodied as an
2 internal disk array controller of the storage system.

1 14. (Original) The system of Claim 10 wherein the storage module is embodied as a disk
2 array control system externally coupled to the storage system.

1 15. (Original) The system of Claim 10 wherein the disk array is a block-based RAID ar-
2 ray.

1 16. (Currently Amended) A method for distributing commodities over containers of a
2 system, the method comprising the steps of:
3 adding a new container to pre-existing containers of the system to thereby provide
4 N containers; and
5 moving ~~only 1/N every Nth commodity of the commodities~~ to the new container
6 to arrange approximately 1/N of the commodities on each container.

1 17. (Original) The method of Claim 16 wherein the system is a storage system, the
2 commodities are data structures adapted for storage on storage devices of an array, and
3 the containers are storage entities coupled to the array.

1 18. (Original) The method of Claim 17 wherein the storage entities are storage heads.

1 19. (Original) The method of Claim 17 wherein the data structures are inode file blocks.

1 20. (Currently Amended) Apparatus for distributing parity across a disk array, the appa-
2 tus comprising:

3 | means for adding a new disk to a number of pre-existing disks of the array;

4 | means for dividing each disk into blocks, the blocks being organized into stripes
5 such that each stripe contains one block from each disk; and

6 | means for distributing parity among blocks of the new and pre-existing disks

7 ~~without recalculation or moving of any blocks containing data~~ by moving every Nth par-
8 ity block to the new disk to arrange each disk of the array with approximately 1/N parity
9 blocks, where N is equal to the number of pre-existing disks plus the new disk.

1 21. (Currently Amended) A computer readable medium containing executable program
2 instructions for distributing parity across a disk array, the executable instructions com-
3 prising one or more program instructions for:

4 | adding a new disk to a number of pre-existing disks of the array;

5 | dividing each disk into blocks, the blocks being organized into stripes such that
6 each stripe contains one block from each disk; and

7 | distributing parity among blocks of the new and pre-existing disks ~~without recal-~~
8 ~~ulation or moving of any blocks containing data~~ by moving every Nth parity block to the
9 new disk to arrange each disk of the array with approximately 1/N parity blocks, where N
10 is equal to the number of pre-existing disks plus the new disk.

1 Please add new claims 22 *et al.*

1 22. (New) The method of claim 1, wherein the step of distributing parity among blocks of
2 the new and pre-existing disks is accomplished without recalculation of parity blocks or
3 moving of any blocks containing data.

1 23. (New) The system of claim 10, wherein the storage module is further configured to
2 assign the parity among the blocks of the new and pre-existing disks without recalcula-
3 tion of parity blocks or moving of any blocks containing data.

1 24. (New) The apparatus of claim 20, wherein the means for distributing parity among
2 blocks of the new and pre-existing disks is accomplished without recalculation of parity
3 blocks or moving of any blocks containing data.

1 25. (New) The computer readable medium of claim 21, wherein the program instruction
2 for distributing parity among blocks of the new and pre-existing disks is accomplished
3 without recalculation of parity blocks or moving of any blocks containing data.

1 26. (New) A method for distributing parity blocks across a disk array, comprising:
2 providing a pre-existing disk array with a number of pre-existing disks, each pre-
3 existing disk divided into a plurality of blocks;
4 assigning data blocks and parity blocks to the pre-existing disks in stripes, where
5 each disk is arranged with approximately one over the number of pre-existing disks of
6 parity blocks per disk;
7 adding a new disk to the pre-existing array to form an expanded array with a new
8 number of disks, where N is equal to the number of pre-existing disks plus the new disk,
9 the new disk divided into a plurality of blocks; and

10 reassigning the parity blocks across the expanded array to arrange the parity
11 blocks with approximately $1/N$ blocks of parity on each disk by moving every Nth parity
12 block stored on each of the pre-existing disks to the new disk.

1 27. (New) The method of claim 26, wherein the reassigning of parity blocks is accom-
2 plished without recalculation of parity blocks or moving of any blocks containing data.

1 28. (New) The method of claim 26, further comprising:
2 moving the parity blocks reassigned to the new disk.

1 29. (New) The method of claim 28, further comprising:
2 zeroing the parity blocks moved to the new disk.

1 30. (New) The method of claim 29, further comprising:
2 storing data blocks in the parity blocks zeroed.

1 31. (New) The method of claim 26, wherein the step of reassigning further includes:
2 creating a fixed pattern of $1/N$ of parity blocks per a repeat interval.

1 32. (New) The method of claim 31, wherein the fixed pattern is not a rotating pattern
2 through the disks of the expanded array.

1 33. (New) A method for distributing parity blocks across a disk array, comprising:
2 providing a pre-existing disk array with a number of pre-existing disks, each pre-
3 existing disk divided into a plurality of blocks;
4 assigning data blocks and parity blocks to the pre-existing disks in stripes, where
5 each disk is arranged with approximately one over the number of pre-existing disks of
6 parity blocks per disk;

7 adding a plurality of new disks to the pre-existing array to form an expanded array
8 with a new number of disks, where N is equal to the number of pre-existing disks plus the
9 plurality of new disks, the plurality of new disks each divided into a plurality of blocks;
10 and

11 reassigning the parity blocks across the expanded array to arrange the parity
12 blocks with approximately $1/N$ blocks of parity on each disk by moving every Nth parity
13 block stored on each of the pre-existing disks to the plurality of new disks.

1 34. (New) The method of claim 32, where the step of reassigning is accomplished with-
2 out recalculation of parity blocks or moving of any blocks containing data.

1 35. (New) The method of claim 32, where the plurality of disks can be any number of
2 disks and there is no limit to the number of disks in the expanded array.

1 36. (New) An apparatus to distribute parity blocks across a disk array, comprising:
2 means for providing a pre-existing disk array with a number of pre-existing disks,
3 each pre-existing disk divided into a plurality of blocks;
4 means for assigning data blocks and parity blocks to the pre-existing disks in
5 stripes, where each disk is arranged with approximately one over the number of pre-
6 existing disks of parity blocks per disk;
7 means for adding a new disk to the pre-existing array to form an expanded array
8 with a new number of disks, where N is equal to the number of pre-existing disks plus the
9 new disk, the new disk divided into a plurality of blocks; and
10 means for reassigning the parity blocks across the expanded array to arrange the
11 parity blocks with approximately $1/N$ blocks of parity on each disk by moving every Nth
12 parity block stored on each of the pre-existing disks to the new disk.

1 37. (New) The apparatus of claim 35, wherein the means for reassigning of parity blocks
2 is accomplished without recalculation of parity blocks or moving of any blocks contain-
3 ing data.

1 38. (New) The apparatus of claim 35, further comprising:
2 means for moving the parity blocks reassigned to the new disk.

1 39. (New) The apparatus of claim 37, further comprising:
2 means for zeroing the parity blocks moved to the new disk.

1 40. (New) The apparatus of claim 38, further comprising:
2 means for storing data blocks in the parity blocks zeroed.

1 41. (New) The apparatus of claim 35, wherein the means for reassigning further includes:
2 means for creating a fixed pattern of $1/N$ of parity blocks per a repeat interval.

1 42. (New) The apparatus of claim 40, wherein the fixed pattern is not a rotating pattern
2 through the disks of the expanded array.

1 43. (New) A apparatus for distributing parity blocks across a disk array, comprising:
2 means for providing a pre-existing disk array with a number of pre-existing disks,
3 each pre-existing disk divided into a plurality of blocks;
4 means for assigning data blocks and parity blocks to the pre-existing disks in
5 stripes, where each disk is arranged with approximately one over the number of pre-
6 existing disks of parity blocks per disk;
7 means for adding a plurality of new disks to the pre-existing array to form an ex-
8 panded array with a new number of disks, where N is equal to the number of pre-existing
9 disks plus the plurality of new disks, the plurality of new disks each divided into a plural-
10 ity of blocks; and

11 means for reassigning the parity blocks across the expanded array to arrange the
12 parity blocks with approximately $1/N$ blocks of parity on each disk by moving every Nth
13 parity block stored on each of the pre-existing disks to the plurality of new disks.

1 44. (New) The apparatus of claim 42, where the means for reassigning is accomplished
2 without recalculation of parity blocks or moving of any blocks containing data.

1 45. (New) The apparatus of claim 42, where the plurality of disks can be any number of
2 disks and there is no limit to the number of disks in the expanded array.

1 46. (New) A system to distribute parity blocks across a disk array, comprising:
2 a pre-existing disk array with a number of pre-existing disks, each pre-existing
3 disk divided into a plurality of blocks;
4 a storage module to assign data blocks and parity blocks to the pre-existing disks
5 in stripes, where each disk is arranged with approximately one over the number of pre-
6 existing disks of parity blocks per disk;
7 an expanded array comprising a new disk and the number of pre-existing disks,
8 where the expanded array includes a new number of disks, the new disk divided into a
9 plurality of blocks, where N is equal to the number of pre-existing disks plus the new
10 disk; and
11 the storage module further configured to reassign the parity blocks across the ex-
12 panded array to arrange the parity blocks with approximately $1/N$ blocks of parity on
13 each disk by moving every Nth parity block stored on each of the pre-existing disks to the
14 new disk.

1 47. (New) The system of claim 45, wherein the storage module is further configured to
2 reassign the parity blocks without recalculation of parity blocks or moving of any blocks
3 containing data.

1 48. (New) The system of claim 45, wherein the storage module is further configured to
2 generate to reassigning the parity blocks in a fixed pattern of $1/N$ of parity blocks per a
3 repeat interval.

1 49. (New) The system of claim 47, wherein the fixed pattern is not a rotating pattern
2 through the disks of the expanded array.

1 50. (New) A system for distributing parity blocks across a disk array, comprising:
2 a pre-existing disk array with a number of pre-existing disks, each pre-existing
3 disk divided into a plurality of blocks;
4 a storage module configured to assign data blocks and parity blocks to the pre-
5 existing disks in stripes, where each disk is arranged with approximately one over the
6 number of pre-existing disks of parity blocks per disk;
7 an expanded array comprising a plurality of new disks and the number of pre-
8 existing disks, where the expanded array includes a new number of disks, the plurality of
9 new disks each divided into a plurality of blocks, where N is equal to the number of pre-
10 existing disks plus the plurality of new disks; and
11 the storage module further configured to reassign the parity blocks across the ex-
12 panded array to arrange the parity blocks with approximately $1/N$ blocks of parity on
13 each disk by moving every N th parity block stored on each of the pre-existing disks to the
14 plurality of new disks.

1 51. (New) The system of claim 49, wherein the storage module is further configured to
2 reassign without recalculation of parity blocks or moving of any blocks containing data.

1 52. (New) The system of claim 49, wherein the plurality of disks can be any number of
2 disks and there is no limit to the number of disks in the expanded array.

1 53. (New) A computer readable medium containing executable program instructions for
2 distributing parity blocks across a disk array, comprising:

3 providing a pre-existing disk array with a number of pre-existing disks, each pre-
4 existing disk divided into a plurality of blocks;

5 assigning data blocks and parity blocks to the pre-existing disks in stripes, where
6 each disk is arranged with approximately one over the number of pre-existing disks of
7 parity blocks per disk;

8 adding a new disk to the pre-existing array to form an expanded array with a new
9 number of disks, where N is equal to the number of pre-existing disks plus the new disk,
10 the new disk divided into a plurality of blocks; and

11 reassigning the parity blocks across the expanded array to arrange the parity
12 blocks with approximately $1/N$ blocks of parity on each disk by moving every N th parity
13 block stored on each of the pre-existing disks to the new disk.

1 54. (New) A computer readable medium containing executable program instructions for
2 distributing parity blocks across a disk array, comprising:

3 providing a pre-existing disk array with a number of pre-existing disks, each pre-
4 existing disk divided into a plurality of blocks;

5 assigning data blocks and parity blocks to the pre-existing disks in stripes, where
6 each disk is arranged with approximately one over the number of pre-existing disks of
7 parity blocks per disk;

8 adding a plurality of new disks to the pre-existing array to form an expanded array
9 with a new number of disks, where N is equal to the number of pre-existing disks plus the
10 plurality of new disks, the plurality of new disks each divided into a plurality of blocks;
11 and

12 reassigning the parity blocks across the expanded array to arrange the parity
13 blocks with approximately $1/N$ blocks of parity on each disk by moving every N th parity
14 block stored on each of the pre-existing disks to the plurality of new disks.